Ensemble Streamflow Predictions in the Três Marias Basin, Brazil

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Hydropower is the main electricity source of Brazil. The related hydropower reservoirs are multi-purpose thus besides efficient and reliable energy production, they are relevant for flood control. In this context, the present study shows results of an Ensemble Streamflow Prediction (ESP) for supporting the operational decision making implemented at Três Marias hydroelectric power project located in the São Francisco River basin in Brazil. It is a large tropical river basin with approximately $55,000 km^2$ up to the Três Marias dam.

The hydrological model used in the study is the MGB-IPH (Modelo de Grandes Bacias from Instituto de Pesquisas Hidráulicas), a large scale distributed hydrological model. Applied in an operational forecasting mode, it uses an empirical data assimilation method to take into account real time streamflow observations to update its state variables. We present results of a hindcast experiment with observed precipitation and streamflow data from the local energy utility, CEMIG (Companhia Energética de Minas Gerais), and from the Brazilian water agency, ANA (Agencia Nacional de Água),. Probabilistic Numerical Weather Predictions (NWP) from CPTEC (Centro de Previsão de Tempo e Estudos Climáticos), ECMWF (European Centre for Medium-Range Weather Forecast) and NOAA (National Oceanic and Atmospheric Administration) are used to generate the ESP.

The data products and the MGB-IPH model are integrated into an open shell forecasting platform based on the software package Delft-FEWS. Inside the forecasting platform a hindcast mode over a forecast lead time of 10-16 days in recent rainfall periods is applied in. The ESP results are compared to deterministic forecasts of the Três Marias reservoir inflow. The results assessment verifies the added value of the ESP in general in comparison to the use of deterministic forecasts by means of different performance indicators. The ESP derived from the ECMWP ensemble shows the best performance.

A future application of the ESP will be the operational short-term management of the Três Marias reservoir. The related multi-stage stochastic optimization procedure is currently under development.